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# First record of *Glyphonycteris daviesi* to the state of Roraima in Brazil

# Primer registro de *Glyphonycteris daviesi* al estado de Roraima en Brasil

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The genus *Glyphonycteris* comprises 3 species that inhabit lowlands and forested mountains of Central and South America. Of the 3 species that occur in Brazil, *Glyphonycteris daviesi* is reported in humid forests but little is known about its distribution limits. We started from a voucher specimen deposited in the Mammals Collection of the Department of Vertebrates at the National Museum, Rio de Janeiro, Brazil. We analyzed the external, cranial, and dental features that have been reported as diagnostic in previous studies and documented georeferenced occurrences of the species in Brazil. We verified that the specimen was an individual of *G. daviesi*. Therefore, we describe the first record of this species for the state of Roraima, at approximately 407 km northwest of the previous closest known record in Manaus. This collection belongs to a male, within the potential distribution for the species according to the IUCN. The landscape from which the collection comes is mainly composed of *campinaranas* (Amazonian ecosystems associated with poor and sandy soils with periodic flooding), humid forests, and floodplains. We confirm that *G. daviesi* occurs in regions of conserved tropical humid forests, corroborating other reports, and in variable vegetation types, from fields to forested areas.

**Key words:** *Campinaranas*; distribution; Phyllostominae; rainforest; Roraima.

El género *Glyphonycteris* comprende 3 especies que habitan en tierras bajas y montañas boscosas de América Central y del Sur. De las 3 especies que se encuentran en Brasil, *Glyphonycteris daviesi* se reporta en bosques húmedos pero se sabe poco sobre sus límites de distribución. Partimos de un ejemplar depositado en la Colección de Mamíferos del Departamento de Vertebrados del Museo Nacional, Rio de Janeiro, Brasil. Analizamos las características externas, craneales y dentales que han sido reportadas como diagnósticas en estudios previos y documentamos ocurrencias georreferenciadas de la especie en Brasil. Verificamos que el espécimen se trata de un individuo de *G. daviesi*. Por lo tanto, presentamos el primer registro de esta especie para el estado de Roraima, aproximadamente a 407 km al noroeste del registro anterior más cercano en Manaus. Este registro pertenece a un macho, dentro de la distribución potencial para la especie según la IUCN. El paisaje del que proviene el registro está compuesto principalmente por *campinaranas* (ecosistemas amazónicos asociados a suelos pobres y arenosos con inundaciones periódicas), bosques húmedos y llanuras aluviales. Confirmamos que *G. daviesi* está presente en regiones de bosques húmedos tropicales conservados, corroborando otros reportes, y en tipos de vegetación variados, desde campos hasta áreas boscosas.

**Palabras clave:** *Campinaranas*; distribución; Phyllostominae; Roraima; selva húmeda tropical.



The Subfamily Glyphonycterinae comprises the genus *Glyphonycteris* Thomas, 1896 (Garbino *et al.* 2020). *Glyphonycteris* was considered a subgenus within *Micronycteris* by Sanborn (1949) and Simmons (1996), later elevated to the category of genus by Simmons and Voss (1998). The genus *Glyphonycteris* is characterized by the absence of a cutaneous appendix in the region of the head that connects the two ears, and the upper internal incisor teeth like the canines, among other morphological traits (Simmons and Voss 1998). Its distribution extends from western México to southeastern Brazil (Tirira *et al.* 2016). The group is considered monophyletic based on molecular data and within the family Phyllostomidae (Baker *et al.* 2003).

Currently, *Glyphonycteris* comprises 3 nominal species: *Glyphonycteris behnii* (Peters, 1865), *G. daviesi* (Hill, 1964), and *G. sylvestris* Thomas, 1896 (Williams and Genoways 2007). These are poorly known species that inhabit lowlands and forested mountains of Central and South America (Williams and Genoways 2007), and all of them occur in Brazil (Garbino *et al.* 2020).

*Glyphonycteris daviesi* is reported in humid forests (Pine *et al.* 1996; Gregorin and Rossi 2005). The species is omnivorous, but little is known about its feeding habits (Reis *et al.* 2017). Its distribution is restricted to Latin America, from Costa Rica to Southeastern Brazil (Pine *et al.* 1996; Reis *et al.* 2017). In Brazil, *G. daviesi* is known to the states of Amapá,

Amazonas, Pará, Rondônia, Bahia, and Espírito Santo (Pine *et al.* 1996; Simmons 1996; Bernard and Fenton 2002, 2007; Marques-Aguiar *et al.* 2003; Sampaio *et al.* 2003; Gregorin and Rossi 2005; Castro and Michalski 2015; Farneda *et al.* 2018; Vela-Ulian *et al.* 2021).

The south of the state of Bahia and the north of Espírito Santo are characterized by the Atlantic Forest of southeastern Brazil, known as Hiléia Baiana. The latter region is considered similar to the Amazon Forest (Gregorin and Rossi 2005), where most records of *G. daviesi* are concentrated. The Amazon and the Atlantic Forest are considered the biomes with the greatest biodiversity in the world. These biomes show high rates of endemism, species richness, and diversity, but both are suffering from severe deforestation (Ribeiro *et al.* 2009; Sobral-Souza *et al.* 2018). Human impacts and climate change are mainly responsible for species loss in both biomes, most severely in the Atlantic Forest (Tabarelli *et al.* 2005; Kirby *et al.* 2006; Sobral-Souza *et al.* 2018). Most of the records of this species come from well-conserved humid forests. Here, we present the first record of *G. daviesi* for the state of Roraima based on a museum voucher specimen and document the vegetation types for its occurrences in Brazil.

The voucher specimen (MN70526) was collected and previously identified in a mammal inventory in the Viruá National Park Management Plan on April 5, 2007 (Oliveira *et al.* 2009) and deposited in the Mammals Collection of the Department of Vertebrates at the National Museum, Rio de Janeiro, Brazil. In the inventory, Chiroptera species were sampled mainly with a mist net, and occasionally by active search. We verified the identification based on external, cranial, and dental features, comparing with data available in the literature (Clarke and Racey 2003; Gregorin and Rossi 2005; Gardner 2007; Reis *et al.* 2017). Measurements were made with a digital caliper with 0.1 mm precision. The nomenclature followed Garbino *et al.* (2020).

The collection locality is in the municipality of Caracaraí, along the Branco River (1° 13' 0'' N, 61° 08' 0'' W), near a small, forested mountain range (Serra do Preto). The lower Branco River basin is characterized by a landscape composed of a mosaic of open areas, represented mainly by meadows and shrubby areas known as *campinaranas* (ecosystems associated with poor and sandy soils with periodic flooding), humid forests, and floodplain forests (Eden and Mcgregor 1992; Oliveira *et al.* 2009; ICMBio 2014). The vegetation of the Viruá National Park left bank of Branco River, has a characteristic that distinguishes it from the savannas of the Branco-Rupununi River complex, with hydromorphic - sandy soils with low water flow. During the rainy season (May to September), most of the area is flooded (Veloso *et al.* 1991; Mendonça *et al.* 2013). The climate in the region is "Af" (Köppen's climate classification) without a dry season, with average annual temperatures in the lowlands between 26-27 °C, an average monthly range of 2-3 °C, and annual rainfall of 2,500-2,800 mm (Alvares *et al.* 2013).

We obtained georeferenced occurrences of *G. daviesi* in Brazil based on several authors (Pine *et al.* 1996; Simmons 1996; Bernard and Fenton 2002, 2007; Marques-Aguiar *et al.* 2003; Sampaio *et al.* 2003; Gregorin and Rossi 2005; Farneda *et al.* 2018; Vela-Ulian *et al.* 2021) and in the databases the Global Biodiversity Information Facility or GBIF (GBIF.org 2021) and SpeciesLink (CRIA 2011). We plotted the records using the ArcGIS Desktop software system (Ormsby *et al.* 2010) and included the IUCN distribution polygon for this

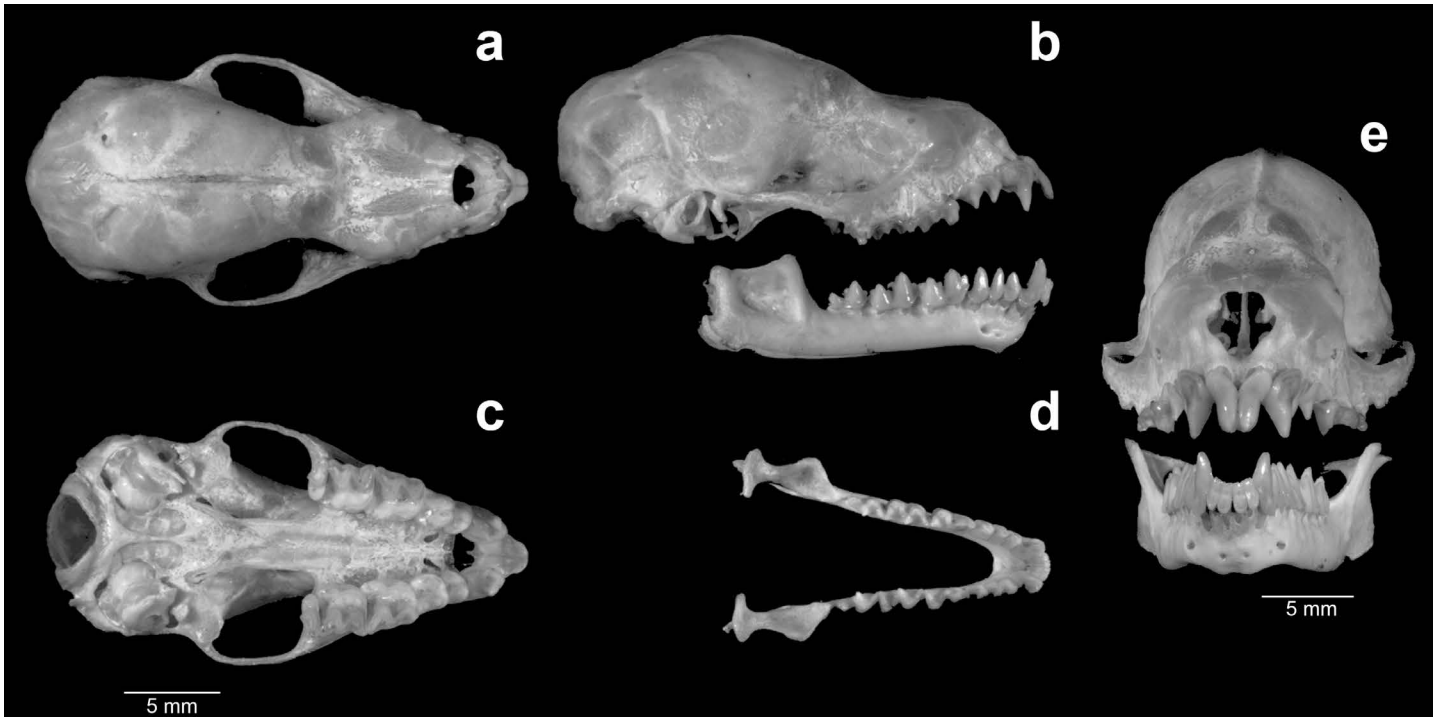


**Figure 1.** Male specimen of *Glyphonycteris daviesi* (MN70526) from the Viruá National Park, in the State of Roraima, Brazil. (a) dorsal, (b) lateral and (c) ventral view of the skull, (d) view of the mandible, and (e) frontal view of the mandible and skull, showing one pair of upper incisors, and crowns of lower incisors anteriorly-posteriorly long and transversely narrow.

species. Complementarily, we documented the vegetation types for its occurrences in Brazil based on the literature and field data available in the inventory report in the region of occurrence (Oliveira *et al.* 2009).

We verified the identity of the specimen as *G. daviesi*. Despite the overlapping geographic distribution of species of *Glyphonycteris* in some locations, *G. daviesi* is the largest representative of the genus and can be set apart from the others by morphological characters. The specimen we analyzed is an adult male, with the smallest number of teeth and a dental formula totaling 32 teeth (i 1/2, c 1/1, pm 2/3, m 3/3), a pair of upper incisors, long crowns in the posterior-anterior orientation, and narrow transversally oriented mandibular incisors (Figure 1). The forearm length is 57.04 mm, and the skull total length is 25.9 mm, and it is within the range of measurements of other specimens of *G. daviesi* (Table 1). Therefore, we present the first record of this species for the state of Roraima, northern Amazon, and document the vegetation types for its occurrences in Brazil (Figure 2; Table 2).

*Glyphonycteris daviesi* is the largest species of the genus (Gardner 2007; Reis *et al.* 2017) and can be clearly distinguished by having one pair of upper incisors, and crowns of lower incisors anteriorly-posteriorly long and transversely narrow (Hill 1964). The measurements of the voucher specimen analyzed here, compared to the literature records are within the range of size variation reported for this species (Hill 1964; McCarthy and Ochoa 1991; Simmons and Voss 1998; Clark and Racey 2003; Gregorin and Rossi 2005; Morales-Martínez and Suárez-Castro 2014; Table 1).

The closest record of *G. daviesi* to the one we described, is 407 km southeast, in the Dimona Reserve (Smithsonian INPA PDBFF Reserve) in the state of Amazonas, Brazil (Sampaio *et al.* 2003), with a predominant habitat of Terra Firme Dense Amazon Forest (Pires and Prance 1985; Sampaio *et al.* 2003). Most records come from highly conserved sites, very

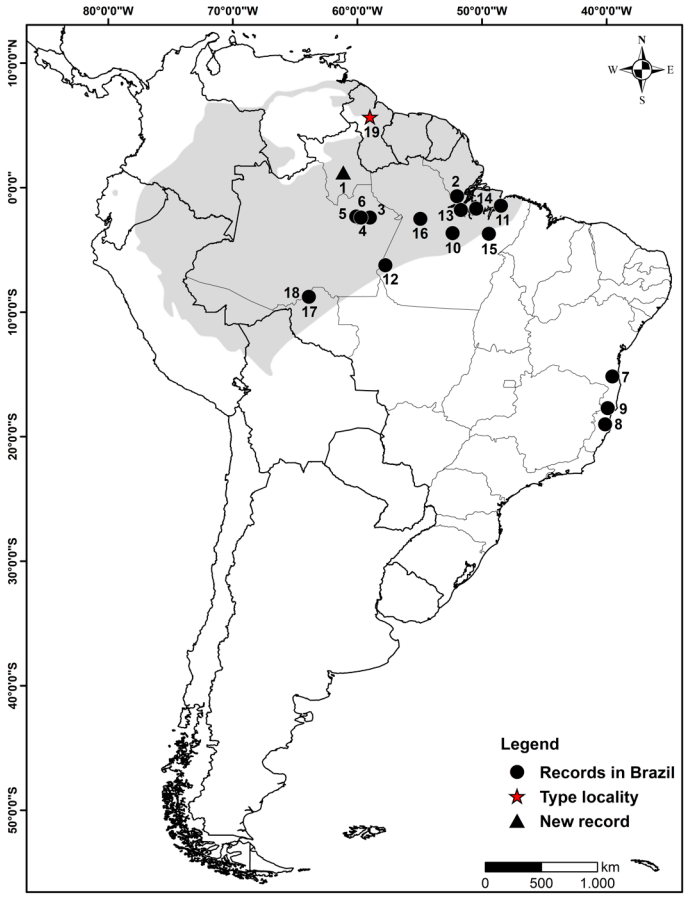


**Figure 2.** Map with the IUCN distribution polygon in gray, with the potential area of occupancy of *Glyphonycteris daviesi*. The numbering is in correspondence with the collection localities in Table 2.

**Table 1.** Summary of external and cranial-dental measurements of the specimen of *Glyphonycteris daviesi* from Roraima, Brazil, compared to the specimens reported by Hill (1964) holotype from Guyana, McCarthy and Ochoa (1991) from Venezuela, Simmons and Voss (1998) from French Guiana, Clark and Racey (2003) from Trinidad, Gregorin and Rossi (2005) from Brazil, and Morales-Martínez and Suárez-Castro (2014) from Colombia. Measurements are given in millimeters and weights in grams. In parentheses the number of individuals examined.

| | Present study | Guyana | Venezuela | French Guiana | | Trinidad | Brazil | Colombia |
|---|---|---|---|---|---|---|---|---|
| Character | Male (1) | Female (1) | Male (2) | Female (1) | Male (1) | Female (1) | Female (2) | Male (1) |
| Weight | 16 | | 20 - 23 | 20 | 17.4 | 22 | 24 - 25 | 18 |
| Total body length | 67.24 | 79 | | 83 | 80 | 83.8 | | 71 |
| Tail length | 11.36 | 10.4 | | 10 | 10 | 8.7 | 5.7 - 6.5 | 5 |
| Hindfoot length | 14.99 | 16.8 | | 17 | 17 | 15 | | 15 |
| Ear length | 25.44 | 17 | | 28 | 27 | 26.5 | 26.4 - 26.2 | 24 |
| Forearm length | 57.04 | 57.5 | 53.6 - 54 | 57 | 52.5 | 56.4 | 56.2 - 58.1 | 55.1 |
| Greatest length of skull | 25.9 | 27.2 | 26.3 - 26.1 | 24.56 | | 24.36 | 27 - 27.4 | 24.6 |
| Condyle-incisor length | 22.56 | 24.7 | 24.9 - 25.2 | 24.58 | | 25.32 | 24.9 - 25.6 | 23.4 |
| Maxillary toothrow length | 10.92 | 11.1 | 10.5 - 10.7 | 10.27 | | 11.7 | 10.9 - 11 | 10.2 |
| Breadth across upper molar | 9.44 | 9.3 | 8.5 - 9 | 8.98 | | 9.2 | 9.3 - 9.6 | 8.8 |
| Breadth across upper canines | 4.43 | 5.2 | | | | | 4.9 - 5.1 | |
| Postorbital length | 5.75 | | 5.9 - 6.1 | 5.97 | | 6.36 | | |
| Zygomatic breadth | 12.89 | 13.3 | 12.1 - 12.6 | 12.68 | | 12.68 | 14 - 13.9 | 12.9 |
| Braincase breadth | 9.97 | 10.9 | 10.3 - 10.8 | 10.27 | | 12 | 10.5 - 10.7 | 10.5 |
| Mastoid breadth | 10.81 | 11.3 | 10.7 - 10.8 | 10.87 | | | | 10.6 |
| Mandible length | 17.55 | 18.5 | | | | | 19.4 - 19.9 | |
| Mandibular toothrow length | 10.50 | 11.3 | 9.3 - 9.7 | | | | | |

similar to the area of the collection locality that we documented (Silva *et al.* 2020), and the new record of *G. daviesi* is within the potential distribution for the species according to IUCN (Solari 2018; Figure 2). Viruá National Park, where the specimen was documented, was created in 1998 and consists of a preserved area with virtually no evidence of recent human activity (ICMBio 2014).

Although of little concern in the list of threatened species (Solari 2018), *G. daviesi* seems uncommon in degraded areas. In Bolivia, *G. daviesi* is classified as vulnerable (Solari 2018), mainly due to the loss of primary forests, and the reduction and fragmentation of its habitat (montane forests and flood plains), that are regional threats (Aguirre 1999). The genus may harbor species particularly sensitive to anthropic pressures. Another species of the same genus, *Glyphonycteris behnii*, was already considered as vulnerable (VU) in the official list of threatened species in Brazil (IN MMA 444/2014); however, it is recently assessed in the Red List of Threatened Species as data deficient (DD; Zortea *et al.* 2016).

Forest degradation and loss, and land use change, consequences of intense human pressure, have been recognized as the main direct threats to biological diversity in tropical regions (Souza *et al.* 2020). Deforestation also influences the issue of climate change, as it is one of the sources of greenhouse gas emissions (Van der Werf *et al.* 2009). Therefore, one of the concerns for this type of species is the rapid deterioration of its habitat and climate change, caused by human activities, which could lead to the loss of it up to 98 % by 2050 (Aguiar *et al.* 2016). In response to habitat loss, the main conservation action is the creation of protected areas (Kirby *et al.* 2006; Ribeiro *et al.* 2009; Sobral-Souza *et al.* 2018). Also, forest regeneration may be associated with a significant recovery in the functional and taxonomic diversity of bats (Farneda *et al.* 2018). Animalivorous bats, such as *G. daviesi*, can also benefit from secondary forest regeneration (Farneda *et al.* 2018).

Finally, with the present record, we confirm that *G. daviesi* occurs in regions of conserved tropical humid forests, corroborating other reports, and in variable vegetation types, from fields to forests, such as open Amazonian areas and *campinaranas*.

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**Table 2.** Locations with confirmed records of *Glyphonycteris daviesi* in Brazil, type of vegetation, references and geographic coordinates. The numbering is in correspondence with the distribution map in Figure 2.

| | Locality | Vegetation | References | Coordinates |
|---|---|---|---|---|
| 1 | Brazil: Roraima, Viruá National Park | Amazonian rainforest , Campinaranas | Present study | 1° 13' 0" N, 61° 08' 0" W |
| 2 | Brazil: Amapá, Ajuruxi River, Cajari Reserve, Vila Maranata | Varzea forest | Castro and Michalski (2015) | 0° 33' 2" S, 51° 33' 49" W |
| 3 | Brazil: Amazonas, Manaus | Amazonian continuous forest | Silva *et al*. (2020) | 2° 24' 0" S, 59° 0' 0" W |
| 4 | Brazil: Amazonas, Manaus, Central Amazonia | Amazonian rainforest, continuous primary forest and secondary forest | Farneda *et al*. (2018) | 2° 25' 0" S, 59° 50' 0" W |
| 5 | Brazil: Amazonas, Manaus, Dimona Reserve | Fragments Amazonian rainforest | Sampaio *et al*. (2003) | 2° 24' 0" S, 59° 43' 0" W |
| 6 | Brazil: Amazonas, Manaus, Gaviao Reserve | Amazonian rainforest undisturbed | Sampaio *et al*. (2003) | 2° 25' 0" S, 59° 45' 0" W |
| 7 | Brazil: Bahia, Jussari, Serra do Teimoso Farm | Rainforest that shares several flora elements with eastern Amazon forest | Gregorin and Rossi (2005) | 15° 09′ 25" S, 39° 32′ 15" W |
| 8 | Brazil: Espírito Santo, Sooretama, Sooretama Biological Reserve | Atlantic Forest | Vela-Ulian *et al.* (2021); CRIA (2011) | 19° 05' 0" S, 40°15' 0" W |
| 9 | Brazil: Bahia, Una, Una Biological Reserve | Tropical lowland rainforest (Hiléia baiana) | Faria *et al*. (2006) | 15° 17' 36" S, 39° 04' 31" W |
| 10 | Brazil: Pará, Altamira, Xingu River | Amazonian rainforest | Pine *et al*. (1996) | 3° 39' 0" S, 52° 22' 0" W |
| 11 | Brazil: Pará, Belém | Amazonian rainforest | Pine *et al.* (1996); Simmons (1996); CRIA (2011); GBIF (2021) | 1° 27' 0" S, 48° 29' 0" W |
| 12 | Brazil: Pará, Jacareacanga, near the Teles Pires River | Amazonian rainforest | CRIA (2011) | 6° 13' 0" S, 57° 45' 0" W |
| 13 | Brazil: Pará, Melgaço, Caxiuanã | Amazonian rainforest | GBIF (2021) | 1° 47' 0" S, 51° 41' 0" W |
| 14 | Brazil: Pará, Melgaço, Ferreira Penna Scientific Station | Amazonian rainforest | Marques-Aguiar *et al.* (2003) | 1° 40' 0" S, 50° 28' 0" W |
| 15 | Brazil: Pará, Tucuruí, Caraipe area | Amazonian rainforest | Pine *et al*. (1996) | 3° 42' 0" S, 49° 27' 0" W |
| 16 | Brazil: Pará, Village of Alter do Chão | Amazonian primary forests | Bernard and Fenton (2002, 2007) | 2° 30' 0" S, 54° 57' 0" W |
| 17 | Brazil: Rondônia, Porto Velho | Amazonian rainforest | CRIA (2011) | 8° 45' 42" S, 63° 54' 14" W |
| 18 | Brazil: Rondônia, Porto Velho, Teotônio Waterfall | Amazonian rainforest | Pine *et al.* (1996) | 8° 46' 0" S, 63° 54' 0" W |
| 19 | Type locality - Guyana: Bartica, along the Potaro Road | Amazonian rainforest | Hill (1964) | 5° 41' 0" N, 58° 59' 0" W |

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